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# West Europe Report

## SCIENCE AND TECHNOLOGY

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# WEST EUROPE REPORT

## Science and Technology

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## Contents

SCIENTIFIC AND INDUSTRIAL POLICY

# FRG RESEARCHERS DEVELOP MAGNESIUM HYDROGEN STORAGE FOR AUTOS

Duesseldorf VDI NACHRICHTEN in German 25 Mar 83 p 15

[Article by T. Fuhrmann: "Auto Runs on Power from Magnesium Hydride Storage. Generation of Hydrogen Metal Compound now Easily Possible"]

[Text] In city traffic, a motor vehicle equipped with a magnesium hydrogen storage may reach a mileage of about 80 miles. A process developed at the Max Planck Institute in Muelheim enables magnesium hydride ($MgH_2$) to be produced substantially faster and simpler than before. The newly developed $MgH_2$ storage unit is capable of accommodating four times as much energy as state-of-the-art metal hydride storages.

The use of hydrogen as a promising secondary carrier of energy has been discussed for quite some time as a solution to current and future energy problems. One of the major problems lies in the storage of hydrogen. It has been known for years that metal hydrogen compounds (metal hydrides) are particularly suitable for this purpose.

Under the guidance of professor B. Bogdanovic of the Max Planck Institute for Coal Research of Muelheim/Ruhr, a team of researchers has succeeded in making a significant step forward into the future of reversible hydrogen storage systems. They developed a storage of magnesium hydride ($MgH_2$) which is able to hold four times as many quantities of energy as the metal hydride storages so far known. The process developed in Muelheim/Ruhr and presented there on 9 March provides for storage of between seven and eight percent in weight of hydrogen (8 MJ/kg to 10 MJ/kg), releasing the hydrogen again at about 570°F (exhaust gas temperature) while supplying energy, whereas other alloys of titanium, chromium and manganese take up only about two percent in weight of hydrogen (2.4 MJ/kg), releasing it, however, already at temperatures from -4°F with energy being supplied (cold air) (hydrogen has a calorific value of about 120 MJ/kg). Depending on the operating conditions (operating temperatures, energy supply), individual metal hydrides or combinations of different hydrides may be used for hydrogen storage.

When comparing the storage of energy in metal hydrides with other possibilities, it will be seen that the energy density of metal hydrides (without storage reservoir), which is between 2 MJ/kg and 10 MJ/kg, is substantially lower than that of fuel (40 MJ/kg), yet considerably higher than that of a lead-acid battery (0.1 MJ/kg).

In practice, this means that the energy content of 50 kg of gasoline corresponds to an 800-kg to 1,000-kg hydride storage (factor 15 to 20) or to a battery weighing between 8t and 10t (factor 160 to 200).

With a storage weight of 300 kg, the Daimler-Benz station wagon (2.3 1 internal-combustion engine, 9:1 compression ratio, rated output 55 kW using hydrogen), achieves a mileage rating of 80 miles under city traffic conditions or 220 miles at constant 30 mph. This is sufficient reason for Daimler-Benz to shift their research efforts from the battery/electric car to the hydrogen-powered car. Until now, Daimler-Benz has spent about DM 20 million on research into the storage problems. The storage units themselves are built in cooperation between Daimler-Benz, Thyssen and Mannesmann. Priced at DM 40/kg which brings the unit price to DM 12,000 per car (DB 230 T model), the storage unit is very expensive; yet, in contrast to the lead-acid battery, it affords the advantage of permitting the hydrogen charging and discharging process to be repeated as often as desired. Pertinent experiments have already been concluded successfully at the Max Planck Institute for Coal Research. Thus, the magnesium hydride storage is in a position to survive the vehicle, whereas for the lead-acid battery rather the reverse is true.

Series application of hydrogen as an alternative fuel is certainly not to be expected before the year 2000. Still, the development does offer a perspective, although, with falling oil prices, there is little doubt that it will be kept on ice for quite some time.

Photo Caption

Magnesium hydride ($MgH_2$) in pressed form is stable when exposed to air and does not ignite. The gas tube is extended through the hole in the metal hydride disc.

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CSO: 3698/6

## BRIEFS

DANISH, CANADIAN BIOMEDICINE JOINT VENTURE--Novo Industrie A/S [of Denmark] has now started to enter the Canadian market in order to sell and produce insulin. The company has just reported that it has entered into a cooperative agreement with the Canadian company of Connaught Laboratories, Limited, and according to this pact, Novo has established a subsidiary, which is 100-percent owned by it, called Novo Laboratories, which will produce insulin for the 200,000 Canadian diabetics who require insulin. In addition Novo and the Canadian company are establishing jointly the Connaught Novo Ltd, with each partner having 50 percent of the share capital. This joint firm will handle promotion, medicinals service and clinical studies. Connaught was the first company in the world to make insulin. This took place in 1921. It is moreover Canada's oldest producer of biological pharmaceuticals and a leading international producer of vaccines. Novo was founded in 1925. If the new companies, as expected, begin their activities in January 1984, the so-called Monocomponent insulins and human insulin will be imported from Denmark. [Text] [Copenhagen BERLINGSKE TIDENDE in Danish 4 Oct 83 Section III p 1]

CSO: 3698/48

COMPUTERS

## NORSK DATA TO BUILD ITS MOST POWERFUL SUPERCOMPUTER

Oslo AFTENPOSTEN in Norwegian 21 Sep 83 p 32

[Article by Ulf Peter Hellstrom]

[Excerpts] Late this year Norsk Data will begin marketing a new minicomputer, which will be that company's most powerful computer unit to date and will contain the latest generation of semiconductor components from Japan in the internal memory of the machine. The new "supermini" 570 CXA will become the company's new flagship product. The new product was announced just before the opening of the large SICOB computer exhibit in Paris last Tuesday. IBM announced new products in its 4300 series and price reductions on existing models.

For Norsk Data the new computer means that its 500 series has become even more advanced. The 570 CXA model is a 32-bit "supermini" computer that can undertake about 3.4 million computational operations per second. This is about twice the speed of the fastest Nord computer today.

The computer is equipped with a working memory of 8 million characters, corresponding to about 4,400 type-written pages. This large memory is the result of a new Japanese integrated circuit, which Norsk Data already uses commercially. Each circuit board contains 156 chips, each of which holds 256,000 bits. Norsk Data announced that the new machine would cost about 50 percent more than the 560 model, even though the new model could handel twice as many computational operations.

The management of the Norwegian computer company stressed that the new model was a general-purpose computer that could be used for scientific and technical applications--the traditional field of Norsk Data--and for administrative purposes in business. Up to 128 terminals can be hooked up to the 570 CXA.

This is the second time this year that Norsk Data has come out with new products in the so-called "supermini" class. These computers fill the gap between mainframe computers that operate at the center of a large network and microcomputers, which are used primarily at one or several work sites. Norsk Data traditionally has concentrated on this type of minicomputer. AFTENPOSTEN learned that the company is working to expand its range of products in order to enter the microcomputer market, which currently is dominated by IBM.

9336
CSO: 3698/8

## DETAILS ON ASEA'S FIRST SEEING, IMAGE-PROCESSING ROBOT

Stockholm NY TEKNIK in Swedish 15 Sep 83 p 3

[Article by Goran Lundstrom]

[Text] ASEA [Swedish General Electric Corporation] is now ready with its seeing robot. The robot sees what it is doing and selects objects by itself.

Experts regard ASEA's new robot as being more advanced than experiments by Japanese competitors.

The seeing robot paves the way for fully automatic production around the clock.

This means that the objects to be processed or assembled will not have to be sorted first by a human being. The robot "sees" the objects and grasps them in the right way even if they are lying in disorder.

ASEA is not the first to come up with an image-processing system for robots. All the major robot manufacturers can supply such systems. But so far there are only about 100 TV-controlled industrial robots in operation around the world.

With its system, ASEA is a step ahead of its competitors in one important respect: its system can be used under ordinary lighting conditions--no special light is required.

Moreover, the robot's control system and the image-processing system form a single unit. Both the robot and the control system can be programmed by plant personnel without special training.

It takes 1 second for the visual system to recognize an oject approaching on a production line.

A lot happens in that 1 second.

From the light-sensitive chip located in the TV camera, 40 million signals go to the computer, where they are sorted and converted into lines corresponding to the contours of the object. Those contours are compared to the contours previously programmed into the computer's memory. At that point, the computer can give the necessary signals so that the robot's gripper will grasp and move the object in the right way.

Programming the system is very simple. The object is shown to the camera in various positions, and the computer "remembers" what the object looks like.

No special lighting is needed because ASEA has used a scale of 64 shades of gray ranging from black to white instead of a binary system. What this means, as one example, is that the system can distinguish gray connecting rods on a black conveyor belt under ordinary fluorescent lighting.

The disadvantage is poor resolution--on a 1-meter-square surface, the system cannot detect any detail measuring less than 20 millimeters.

The system has been undergoing tests by industry for the past few months. For competitive reasons, ASEA does not want to say where. ASEA uses one of these image-processing systems in its production of relays. The TV camera is programmed to distinguish each of 12 parts that the robot is to grasp and burr on a grinding machine.

Lastly, it is not technology, but price, that will determine whether ASEA succeeds on the market with its image-processing system. But no definite price has been decided on. There is talk of "a couple of hundred thousand" kronor.

PHOTO CAPTION

1. p 3. The TV camera's image of the axles on the pallet is converted and simplified into outline images that are used, for example, to guide the robot in grasping them.

11798
CSO: 3698/5

FACTORY AUTOMATION

FABIUS ANNOUNCES PLAN FOR COMPUTER INTEGRATED MANUFACTURING

Paris AFP SCIENCES in French 22 Sep 83 pp 5-6

[Text] Ris-Orangis--Mr Laurent Fabius, minister of industry, confirmed on 15 September the forthcoming launching of a CIM [Computer Integrated Manufacturing] program, which, for enterprising tooling up with this type of equipment, will represent a lowering of their social charges and a lightening of their tax bill.

CIM is of very particular interest to the manufacturing industries (20,000 enterprises employing one-third of the industrial work force, or 2 million wage earners). These enterprises have been undergoing a decline in competitiveness for the past several years, as well as a declining rate of investment. In 1982, they posted a foreign trade deficit of 9 billion francs.

The government program, which will span 3 years, has not yet been finalized in complete detail, said the minister, who visited a CIM plant--SEIV [expansion unknown] Automation (a subsidiary of Renault) at Ris-Orangis, in the outskirts of Paris. However, this is expected to be done within something "on the order of a month."

Enterprises will be able to obtain financial aid for their modernization studies, and "pilot projects" will be built. These projects will bring the builders and the users together on very advanced state-of-the-art equipment ventures that will have a highly exemplary impact.

On the basis of proposals, conventional development contracts will be signed with producers. These will be of interest, for example, to large enterprises like MATRA [Mechanics, Aviation and Traction Company], Renault and CGE [Geneneral Electric Company], but also to units of smaller size.

The CIM program will also include provisions for training, particularly with respect to engineers and technicians. In addition, the Ministry of National Education will purchase CIM equipment. And lastly, Mr Fabius announced the establishment of a specific program for research in this domain.

Since detailed planning of this program has not been completed, the minister did not indicate the amount of the total financial package that will be devoted to it. But he did state that the objective is to increase by 10 percent, in terms of volume, the investment of the enterprises that tool up with this type of equipment.

9238
CSO: 3698/21

## ASEA WANTS TO MARKET NEW ELECTRONIC CONTROL, MONITORING SYSTEM

Sundbyberg MODERN ELEKTRONIK in Swedish 31 Mar 83 p 5

[Text] This year ASEA [Swedish General Electric Corporation] turned 100 years old, and it is also getting ready to introduce a new electronic system--the ASEA Master--for monitoring and control.

A new feature in this connection is that to a greater extent than before, the company will go out and compete on the open market with its Master system. Among other things, its intention is to grab a considerable share of the so-called PC market.

ASEA's electronics activity in the field of control and monitoring dates back to the 1960's, when it introduced its first generation of industrial electronics. In 1968 it came out with a minicomputer-based system, and that was followed in 1974 by the PLC-700 PC system and in 1975 by the DS-8 up-system. And now--in 1983--it is time for the Master system.

The Electronics Division, which produced the Master system, currently employs about 1,700 people and has a turnover of 700 million kronor. To a great extent, the division's products are used in other ASEA products and plants, where they represent a total delivery value on the order of 4 or 5 billion kronor.

Development of the new Master system began with a preliminary study in 1977, and actual development began 2 years later.

About 100 people have been involved in its development, and all told, the labor input represented 500 man-years at a cost of 150 million kronor, according to Gunnar Mellgren, who heads the Industrial Electronics subdivision.

But introduction of the Master system involves more than just a new system. Bo Hermansson, manag r of the Electronics Division, says that the commercial aspect is also the subject of some rethinking.

"So far, our electronics have been sold internally, but now we intend to make a bigger effort on the open market. About 80 percent of our electronics are now sold within the group, but we will increase our outside sales to 40 percent between now and 1987, and at the same time we expect to increase our sales by 20 percent per year."

That objective was also stressed by ASEA's head, Percy Barnevik, during a speech delivered later the same day, when he emphasized the great importance of electronics to the entire company operation.

"Electronics is essential if we are to keep up with the competition, and it is no accident that we are investing 40 percent of our research and development budget precisely in electronics."

From the Smallest up

The Master system provides the complete distributed and decentralized systems structures required in large installations while also constituting a very good foundation for the development of smaller, more independent PC systems and other equipment-based products. The system's design and range of functions are such that it can "be programmed by someone with no knowledge of programming." This means that products and product-based systems built up from the ASEA Master can be modified for specific requirements through parameter specification and application-oriented PC programming without the need to use a programming language. It makes modification as simple as it is reliable.

Building Blocks and Systems

The ASEA Master comprises a broad, general microcomputer and electronic building block system with a large number of building blocks in the form of both hardware and software (between 100 and 200 of each) on the one hand and, on the other, a constantly growing number of product-based devices, products, and systems based on the Master system and designed by ASEA. These may be completely free-standing devices, small or large, but they can also communicate with each other and be combined to make larger systems, which in turn can also become building block systems at a higher level.

Today, for example, there are three types of PC systems: the Master Piece 10, the Master Piece 100, and the Master Piece 200. The smallest is a Japanese product in the low price range. It is designed for the very simplest types of applications. Models 100 and 200, on the other hand, are "genuine" Master products.

Simple Programming

The ASEA Master and its modules are "programmed" partly by parameter specification and partly by control and modification programming in a special PC language. This programming differs from conventional computer programming in that it is considerably more reliable and in many respects much simpler.

As far as its hardware is concerned, the ASEA Master is based on a number of microcomputers and microprocessors, both 16/32 bit (the 68,000 family) and 8 bit. In addition to the central microcomputer cards, one or more microprocessors have several cards--for example, communication cards and certain process modification cards.

The ASEA Master's hardware and software are both so designed that the system can satisfy the requirements for geographical and functional distribution that are presented by modern control system structures.

A more complete technical description of the Master system will appear in the next issue of MODERN ELEKTRONIK.

Big Ambitions

It is obvious that ASEA places great hopes in its new electronic system, and it is obvious that other suppliers of PC systems (SattControl, for example--see page 4 of this issue [not included]) are going to encounter stiff competition from Vasteras. In response to MODERN ELEKTRONIK's direct question as to how big a share of the available Swedish market ASEA expects to capture, the answer was:

"We are aiming at 50 percent at least!"

PHOTO CAPTIONS

1. p 5. It is partly with PC systems like the one pictured that ASEA intends to conquer 50 percent of the Swedish market. To the left is the equipment for program development, and to the right are the three standard Master Piece systems: the 10, the 100, and the 200.

2. p 5. The Electronics Division has a large department for developing programs for the Master system. The programmers work with a large main computer, but each work station also has a so-called home computer built from Master system components.

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CSO: 3698/5

## BRIEFS

SIEMENS, GMD CHIP PROJECT--Completion of the first prototypes of a VLSI circuit in cooperation between SIEMENS AG and GMD [Society for Mathematics and Data Processing] is expected by end of 1983. The purpose of this cooperation is to provide a component which, being inserted at the interface between processor and storage, increases the fail-safe capabilities of the connected storage. While GMD of St. Augustin will develop the design of the VSLI circuit, the Munich computer manufacturer will have advisory and "feeder" functions, planning to carry the design into effect with its "tools." [Text] [Cologne ONLINE in German Apr 1983 p 12]

CSO: 3698/6

SCIENTIFIC AND INDUSTRIAL POLICY

# COMPETITIVENESS OF FRG HIGH TECH INDUSTRIES ON WORLD MARKET

Berlin IFO-SCHNELLDIENST in German No 17-18 1982 pp 48-57

[Article by Blau, H., Faust, K., Richter, S., Schedl, H.: "The Position of German Industry in Technology Competition on an International Level"]

[Excerpts] The success of an investment venture is decided not only by the attainable increase in productivity but also by the competitiveness of the enterprise in the particular production sector. This means that the engineering solution which was selected for the investment project must lead to internationally competitive products. The exact determination of the technological position of an enterprise or an entire branch compared to the most important competitors consequently is an essential aspect of the preparation of investment decisions. Analysis shows that this is possible only on the basis of detailed investigations.

## Starting Points for the Determination of the Technological Competition Position

An analysis of German industry's technological position was prepared as part of the 1980 IFO [Economic Research Institute] structural report[1]; the data base extended only up to 1977 here. In the meantime, it has been possible to expand the data base up to 1980 for the 1983 structural report and considerably to enlarge that base also in some of the component fields. Research work has not yet been completed; the following report therefore is only a preliminary one.

Because the technological position is determined by the efficiency and the intensity of the national economic innovation process, we must above all consider the data relating to that process as indicators.[2] Here we are mostly interested in R&D expenditures as input factors and patent activities as a measure of R&D output. In looking at these data we must keep in mind a "time lag" of several years between the situation described and the particular technological competitive position regardless of the statements we can make on the basis of the type of determination and preparations. An analysis of foreign trade with high-tech products enables us to draw direct conclusions as to the technological competitive position.

## Good Position in Trade with High-Tech Products

It is customary in this connection to measure the share of a defined selection of product groups out of the entire trade volume. The selection criterion usually is the expenditure for research and development in the particular branches. In the United States, for instance, investigations were published on this basis already in 1979 and the EC very recently included trade with high-tech products in comparisons of industry's international competitiveness.[3] As part of the structural reporting effort, the HWWA [expansion unknown] Institute of Economic Research in Hamburg[4] and the IFO Institute[5] examined the development of technology intensity in German foreign trade on the basis of an almost congruent product selection. Depending on the weight of the selected products in the total trade volume, the development of the high-tech sector will also more or less strongly approach the development of the entire processing industry. In the following we will therefore only fall back on the product selection for technology-intensive products (including high-tech products) which was used by the IFO Institute in its structural reporting. As we can see in Table 1, the delivery share of the United States and the FRG out of the world trade volume with technology-intensive products is equal with a figure of 18 percent whereas the United States dominates with 33 percent in high-tech-intensive products. The relationship between high-tech products and the totality of technology-intensive products in the threshold countries is striking here because in this case--in contrast to the FRG and Japan--a higher delivery share is recorded here for high-tech products than for the totality of the technology-intensive products. This can be explained by saying that, in 1980, the threshold countries already delivered a large volume of structural components for electronics which were listed as high-tech products.[6] As regards the FRG, we must keep in mind that it in 1980 likewise holds second place after the United States in trade with technology-intensive products. Observers of technological development however again and again note rather critically that the industry of the FRG is rather considerably behind in the use of microelectronics as a base innovation. As part of the structural report, we therefore investigated the development of delivery shares for products where the use of microelectronics is significant. Table 2 shows the development for these products up to 1980--broken down by the inclusion of electronics in primary or secondary functions.

In analyzing the development of trade in the area of products with electronics main functions [high technology], it must be kept in mind that we are dealing here with two different product areas:

Products with a high-tech character, for example, data processing systems and electromedical instruments as well as

Products of mass-production character, for example, radios or watches.

It also turns out that the FRG was unable to achieve any export successes on any of these markets in recent years. It was above all the United States and the threshold countries in Southeast Asia that were able to expand their shares out of the world trade volume. The growth of American exports in recent years can be traced back above all to product areas with a high-tech character while the growth rates of the threshold countries were determined

mostly by mass production. The decline in the Japanese share between 1977 and 1980 was due to the decrease in delivery shares for mass-produced articles.

Table 1. Delivery Shares of Selected Countries for Technology-Intensive Products
Shares in %

| 1 | Technologieintensive Produkte a) 4 A | | | darunter »Hoch-technologie« a) 5 B | | | durchschnittliche jährliche Veränderungsraten in % 6 A | | B | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1970 | 1977 | 1980 | 1970 | 1977 | 1980 | 1970-80 | 1977-80 | 1970-80 | 1977-80 |
| 2 | 20,6 | 20,3 | 18,1 | 8,3 | 10,2 | 9,7 | - 1,3 | - 3,8 | 1,6 | - 1,7 |
| | 21,9 | 16,6 | 18,2 | 48,1 | 33,8 | 33,3 | - 1,8 | 3,1 | - 3,6 | - 0,5 |
| | 9,0 | 15,6 | 15,6 | 4,9 | 7,7 | 4,7 | 5,7 | 0 | - 0,4 | -15,2 |
| 3 | 0,6 | 2,0 | 2,5 | 0,9 | 6,1 | 4,7 | 15,3 | 7,7 | 18,0 | - 8,3 |

Key: 1--Country; 2--FRG; 3--Southeast Asian threshold countries (b); 4--Technology-intensive products (a); 5--Including "high-technology" (a); 6--Average annual change rates in %; (a) See IFO Institute of Economic Research, "Zwischenbericht zur Strukturberichterstattung 1979" [Interim Report on the 1979 Structural Report), Material Volume 2, p XLVII; (b) Hongkong, Malaysia, the Philippines, Singapore, South Korea, Taiwan. Source: OECD, Trade by commodities, Series C.

Table 2. Delivery Shares of Selected Countries for Products with Electronics Main Functions and Electronics Secondary Functions
Shares in %

| | | | | | |
|---|---|---|---|---|---|
| | | 4 | Elektronik-Hauptfunktionen | | |
| Lieferanteil 1980 | 1 | 12,0 | 22,1 | 18,2 | 10,9 |
| durchschnittliche jährliche Veränderungsrate 1970-80 in % | 2 | - 1,5 | 2,0 | - 1,1 | 15,0 |
| durchschnittliche jährliche Veränderungsrate 1977-80 in % | 3 | - 3,4 | - 0,2 | 4,5 | 6,6 |
| | | 5 | Elektronik-Nebenfunktionen | | |
| Lieferanteil 1980 | 1 | 21,4 | 21,3 | 13,9 | 0,4 |
| durchschnittliche jährliche Veränderungsrate 1970-80 in % | 2 | - 0,9 | 9,2 | - 2,6 | 23,1 |
| durchschnittliche jährliche Veränderungsrate 1977-80 in % | 3 | - 0,5 | 5,6 | - 4,2 | 17,0 |

Key: 1--1980 delivery share; 2--Average annual change rate for 1970-1980, in %; 3--Average annual change rate for 1977-1980, in %; 4--Electronics main functions [high technology]; 5--Electronics secondary functions [mass production]; BRD--FRG; SSL [Southeast Asian Threshold Countries] (a) Southeast Asian Threshold Countries: Hongkong, Malaysia, South Korea, Taiwan, the Philippines, Singapore. Source: OECD, Trade by commodities, Series C.

## Growing Competitive Pressure from Japan and the Threshold Countries in Products with Electronics Secondary Functions

In the area of products with electronics secondary functions [electronics mass production], the world trade shares of the FRG and Japan were almost equal in 1980. While the FRG revealed a declining trend during the 1970's, the share of Japanese suppliers definitely went up. United States exporters have to accept a bigger drop than the German exporters. They were the first to be hit by growing competitive pressure from Japan and the threshold countries.

The slight decline of the German delivery share in recent years for electronics mass production articles does not express the fact that very heavy position losses materialized in some of the product groups that are important for German exports. The maintenance of the delivery shares in the auto sector had a stabilizing effect here on the whole. Particularly hard-hit were the machine-building areas under the heading of machine tools and machines for lifting and conveying. Delivery share losses of several percentage points developed in both areas. Extreme drops were also recorded in the typewriter sector; here the delivery share dropped from 28.3 percent in 1977 to 21.1 percent in 1980. A definite rise in the Japanese and American delivery shares was recorded in all of the three areas mentioned in recent years.

Position losses in the area of electronics mass production [electronics secondary functions] are the more significant for German industry since a good 18 percent of all German exports were transacted in this area (only barely 5 percent of the exports were in the electronics high-tech area). Looking at it overall we can also see that only a considerably smaller share of German exports consists of microelectronics-intensive products--that is, 23 percent--than in the case of Japan; there the figure was about 40 percent in 1980.

## Patent Statistics: Difficult and Expensive but High Information Content

German industry's technological position in the field of microelectronics was studied as part of the 1980 structural report on the basis of patent statistics for 14 practical application areas. In the meantime the data base has been greatly expanded. About 70 percent of the data inventory of INPADOC, Vienna, were used for the currently available data processing volume; that data inventory has in the meantime grown to about 9 million documents. This signifies access to 3.2 million inventions which were applied for 2.6 million times abroad. As part of our investigation approach we are primarily interested in the number of foreign patent applications because that must be considered a criterion for the measurement of an invention's economic significance.[7] Out of the 760,000 foreign patent applications registered between 1976 and 1981, the FRG accounted for 156,000, the United States accounted for 239,000, and Japan accounted for 78,000.

Table 3. Shares of Selected Countries in Foreign Patent Applications and Out of OECD Trade in the Processing Industry, in %

| 1 Land | 5 Anteile an den Auslandspatent-anmeldungen 1976 - 1981 7 in ausgewählten Bereichen a) | Lieferanteile im verarbeitenden Gewerbe b) 1980 6 |
|---|---|---|
| 2 BR Deutschland | 20,5 | 16,9 |
| 3 Frankreich | 7,4 | 8,5 |
| 4 Großbritannien | 9,1 | 8,6 |
| USA | 31,4 | 12,4 |
| Japan | 10,2 | 12,5 |

Key: 1--Country; 2--FRG; 3--France; 4--Great Britain; 5--Share out of foreign patent applications; 6--Delivery shares in processing industry (b), 1980; 7--In selected areas (a); (a) Excluding patent fields which contain exclusively armaments, essential foods, and others, about 70 percent of all patent applications during the period of time considered; (b) Excluding essential and nonessential foods. Source: INPADOC; CECD, Trade by commodities, Series C; calculations by IFO Institute.
Note: Applications filed for an invention with the European Patent Office were weighted with the factor of 6.5 in keeping with the average number of countries for which the desired patent protection is to apply. This is why "half" patent applications may come up in the tables.

No Generally Valid Tendencies in Evidence

The sectors selected in Table 4 for the determination of German industry's technological position took a share of 42.8 percent out of German exports in 1980. German industry's delivery share in these sectors is 18.6 percent, in other words, above that of the processing industry, while the share of German foreign patent applications roughly corresponds to that of the entire patent volume analyzed by us. By adding up the number of foreign patent applications for the selected foreign trade sectors, excluding double recordings of IPC symbols, we get a larger number than the total number of existing foreign patent applications because the inventions, as we said above, can be classified under several IPC symbols at the time the applications are filed with the various national patent offices. (One can use as many as 40 IPC symbols for describing an invention.) In our analysis we always considered all IPC symbols that were assigned because this gives us a hint as to the range of effectiveness of the individual inventions.

Table 4. German Industry's Technological Position Measured by Foreign Patent Applications in Important Foreign Trade Sectors Compared to Foreign Trade Shares

| 1 | 2 | 3 Auslandspatentanmeldungen in der Welt | | | | | 4 Außenhandel | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 10 Anteile in (1980) | | |
| SITC-Nr. | Bereich 5 | Veränd. insg. 1976-81 gegenüber 1972-75 (in %) | Anzahl insges. 1976-81 6 | Anteil der BR Deutschland 1976-81 (in %) 7 8 | Anteilsveränd. d.BR Deutschld. 1976-81 gg.1972-75 (in Prozentpunkten) 9 | Hauptkonkurrenzländer 11 | Lieferanteil der BR Deutschland | am Export der BR Deutschland 12 | am OECD-Handel insges. 13 |
| 67 | Eisen und Stahl | - 14 | 12.747,0 | 19,2 | - 0,1 | US,J | 17,5 | 6,0 | 3,9 |
| 14 | Chemie | | | | | | | | |
| 54 | Pharmazeut.Erzeugnisse | + 6 | 86.619,0 | 16,3 | - 1,9 | US,GB,J | 20,1 | 1,4 | 0,9 |
| 554.2 | Waschmittel | - 4 | 9.881,5 | 22,4 | + 5,7 | US,BB | 30,5 | 0,3 | 0,1 |
| 56 | Düngemittel | 0 | 2.636,5 | 20,6 | + 1,1 | US | 8,3 | 0,3 | 0,5 |
| 591 | Insektizide,Herbizide etc. | + 9 | 32.238,5 | 34,0 | + 1,2 | US | 19,3 | 0,4 | 0,2 |
| 15 | Maschinenbau | | | | | | | | |
| 718.7 | Kernreaktoren | + 11 | 9.463,0 | 28,2 | + 2,2 | US,F | 14,6 | 0,1 | 0,1 |
| 721 | Landwirtsch.Maschinen | + 20 | 10.687,0 | 19,0 | + 1,5 | US | 17,3 | 0,5 | 0,3 |
| 723.4 | Bau-u.Bergbaumaschinen | - 13 | 8.983,5 | 16,3 | - 0,3 | US,F | 13,8 | 0,5 | 0,4 |
| 723.44 | Tiefbohrgeräte | + 52 | 9.028,0 | 8,2 | + 1,6 | US,F | 3,0 | 0,0 | 0,0 |
| 724 | Textilmaschinen a) | - 22 | 26.315,5 | 18,3 | - 1,8 | US,J,CH | 25,6 | 1,0 | 0,4 |
| 724.7 | Gewerbl.Wasch-u.Reinigungsmaschinen | - 24 | 24.100,0 | 32,1 | + 2,5 | US,CH,GB | 38,7 | 0,4 | 0,1 |
| 725 | Papiermaschinen | + 21 | 4.141,5 | 12,8 | + 0,2 | US | 26,9 | 0,4 | 0,2 |
| 726 | Druckereimaschinen | - 24 | 8.071,5 | 28,7 | + 6,7 | US | 36,6 | 0,7 | 0,2 |
| 728,42 | Kautschuk-u.Kunstst.Masch. | - 13 | 39.970,0 | 20,8 | - 2,1 | US,GB | 38,5 | 0,4 | 0,1 |
| 736 | Werkzeugmaschinen | + 2 | 38.649,5 | 22,6 | + 0,1 | US | 28,7 | 1,7 | 0,7 |
| 741.4 | Kalteerzeugung | + 24 | 7.379,0 | 19,6 | + 3,1 | US,F | 9,7 | 0,1 | 0,1 |
| 741.5 | Klimatechnik | - 8 | 4.503,5 | 20,1 | - 2,5 | US,J | 5,9 | 0,1 | 0,1 |
| 742,743 | Pumpen u. Verdichter | - 3 | 10.903,5 | 22,7 | + 2,8 | US,GB | 21,6 | 1,6 | 0,8 |
| 744.2 | Hebezeuge/Fördermittel | - 8 | 10.324,0 | 17,8 | - 1,2 | US,F | 17,3 | 0,6 | 0,4 |
| 745.22 | Verpackungsmaschinen | - 9 | 13.581,0 | 18,3 | + 1,5 | US | 35,5 | 0,4 | 0,1 |
| 745.25) 874.51) | Waagen u.Feinwaagen | + 5 | 2.512,0 | 23,2 | + 3,8 | US,CH | 35,3 | 0,1 | 0,0 |
| 749.1 | Wälzlager | - 28 | 929,5 | 24,0 | + 5,2 | US | 26,9 | 0,5 | 0,2 |
| 16 | Büromaschinen u.ADV | | | | | | | | |
| 751.1 | Schreibmaschinen | + 27 | 9.212,0 | 17,5 | - 2,6 | US,J | 22,5 | 0,2 | 0,1 |
| 752 | ADV | + 18 | 50.543,0 | 12,8 | - 0,7 | US,J | 12,5 | 0,8 | 0,7 |
| 17 | Elektrotechnik | | | | | | | | |
| 716 | Elektr.Kraftmaschinen | 0 | 16.682,0 | 24,3 | - 3,1 | US | 19,2 | 0,6 | 0,4 |
| 761 | Fernsehgeräte | + 2 | 19.769,5 | 12,5 | + 0,4 | US,J | 20,2 | 0,6 | 0,3 |
| 762 | Rundfunkgeräte | - 2 | 6.559,0 | 17,8 | - 3,1 | US,J | 4,8 | 0,2 | 0,4 |
| 763.18) 763.88) | Tonaufnahme-u.WG.-geräte | + 9 | 21.285,5 | 13,0 | + 0,1 | US,J | 5,4 | 0,1 | 0,2 |
| 763.81 | Videorecorder | - 8 | 4.231,0 | 7,3 | + 1,6 | J,US | 4,25 | 0,1 | 0,1 |
| 764.1 | Drahtgebundene Fernspr.-u.Telegr.technik | + 23 | 25.036,0 | 22,8 | + 0,2 | US,F | 18,5 | 0,3 | 0,2 |
| 771.1 | Transformatoren | - 1 | 9.407,0 | 23,6 | - 1,4 | US,J | 18,3 | 0,2 | 0,1 |
| 772.1 | Schaltgeräte | - 5 | 15.063,5 | 26,2 | - 0,9 | US,F | 24,6 | 1,4 | 0,6 |
| 773.1 | Isolierte Drähte | - 7 | 6.552,5 | 19,3 | - 2,8 | US,F,J | 15,9 | 0,4 | 0,3 |
| 774 | Elektromedizin | + 30 | 19.077,0 | 19,1 | + 0,9 | US,J | 22,9 | 0,3 | 0,2 |
| 775 | Haushaltgeräte | + 12 | 9.441,0 | 27,9 | + 4,5 | US | 22,0 | 0,9 | 0,5 |
| 776.4 | Elektron.Mikroschaltg. | + 58 | 7.271,5 | 15,3 | - 0,2 | US,J | 8,2 | 0,3 | 0,4 |
| 778.1 | Batterien u.Akkumulator. | + 9 | 8.578,0 | 11,7 | - 5,9 | US,GB,F | 14,7 | 0,2 | 0,1 |
| 874 | El.Meß-,Prüf-,Regelgeräte | + 21 | 112.239,5 | 19,2 | + 0,9 | US,J | 17,4 | 1,3 | 0,9 |
| 78 | Straßenfahrzeuge | + 3 | 74.543,5 | 23,5 | + 1,4 | US,GB,J,F | 21,9 | 14,3 | 7,4 |
| 792 | Flugzeuge | + 19 | 4.831,5 | 12,9 | + 2,2 | US,F,GB | 8,9 | 1,4 | 1,7 |
| 18 | Feinmechanik/Optik/Uhren | | | | | | | | |
| 751.82 | Elektrostat.Fotokopierger. | - 11 | 10.967,0 | 14,4 | + 1,4 | US,J | 13,2 | 0,2 | 0,1 |
| 871.03 | Elektronenmikroskope | - 27 | 434,5 | 24,7 | + 2,1 | J,US | 12,1 | 0,0 | 0,0 |
| 871.04 | Optische Mikroskope | - 27 | 694,5 | 31,0 | + 12,8 | US,J | 56,7 | 0,1 | 0,0 |
| 881 | Fotograph.App.u.Ausrüst. | - 4 | 14.460,0 | 22,5 | + 2,5 | US,J | 16,2 | 0,4 | 0,3 |
| 885 | Uhren | - 10 | 4.905,5 | 16,4 | + 3,8 | US,CH,J | 8,0 | 0,3 | 0,4 |
| 19 | Sonstige | | | | | | | | |
| 625 | Reifen | - 11 | 5.864,5 | 11,3 | - 0,7 | US,F,J | 12,2 | 0,5 | 0,5 |
| 791 | Schienenfahrzeuge | - 17 | 7.529,0 | 27,1 | - 4,7 | US,F | 16,4 | 0,2 | 0,2 |
| 20 | Summe der Bereiche | + 3 | 815.692b) | 20,3 | + 0,3 | | 18,6 | 42,8 | 25,9 |

[Key on following page]

[See Table 4 on preceding page]

Key: 1--SITC No; 2--Sector; 3--Foreign patent applications worldwide; 4--Foreign Trade; 5--Change, overall, 1976-1981, as compared to 1972-1975 in %; 6--Total number 1976-1981; 7--FRG share, 1976-1981 in %; 8--1976-1981 FRG share change compared to 1972-1975 in percentage points; 9--Chief competitor countries; 10--Shares in 1980; 11--FRG delivery share; 12--Out of FRG exports; 13--Out of OECD trade, total; 14--Chemical industry; 15--Machine-building; 16--Office machines and ADV [general data processing?]; 17--Electrotechnology; 18--Precision mechanics, optics, watches; 19--Miscellaneous; 20--Sum of sectors; 67--Iron and steel; 54--Pharmaceutical products; 54.2--Detergents; 56--Fertilizer; 591--Insecticides, herbicides, etc.; 718.7--Nuclear reactors; 721--Agricultural machinery; 723.4--Construction and mining machines; 723.44--Deep-drilling equipment; 724--Textile machines (a); 724.7--Commercial washing and cleaning machines; 725--Paper machines; 726--Print shop machines; 728-42--Rubber and synthetics machines; 735--Machine tools; 741.4--Refrigeration; 741.5--Air conditioning; 742, 743--Pumps and condensers; 744.2--Hoisting gear, conveyors; 745.22--Packaging machines; 745.25 and 874.51--Scales and precision scales; 749.1--Roller bearings; 751.1--Typewriters; 752--ADV; 716--Electrical power machines; 761--Television sets; 762--Radios; 763.18 and 763.88--Tape recorders and [illegible] instruments; 763.81--Videorecorder; 764.1--Wire telephone and telegraph equipment; 771.1--Transformers; 772.1--Switching equipment; 773.1--Insulated wires; 774--Electromedicine; 775--Household appliances; 776.4--Electronic microcircuit equipment; 778.1--Batteries and storage batteries; 874--Electrical measurement, testing, and regulating instruments; 78--Road vehicles; 792--Aircraft; 751.82--Electrostatic photo copying equipment; 871.03--Electron microscopes; 871.04--Optical microscopes; 881--Cameras and accessories; 885--Watches; 65--Tires; 791--Rail vehicles; (a) Exluding 724.7 and 724.8; (b) Excluding foreign patent applications filed several times over (23, 105.5); CH--Switzerland. Source: INPADOC; OECD, Trade by commodities, Series C; calculations by IFO Institute.

The analysis based on foreign trade sectors shows that, in the various branches of machine-building, the delivery shares showed a rising tendency over the share of the FRG out of foreign patent applications while in the other sectors we can observe the opposite ratio. This leads us to assume that the inclination toward patent applications in machine-building is less--due to the size of the enterprises and the know-how advantages--than in the other selected sectors. One would have to investigate whether the lesser interests in patent protection abroad might not lead to market share losses in long-range terms.

Increases in the German share out of the foreign patent applications amounting to more than 2 percent were to be observed mostly in sectors where the total number of foreign patent applications declined worldwide. Exceptions here are the nuclear reactor, refrigeration, scales, household appliances, and aircraft sectors. This development can be explained by saying that--in fields with declining dynamics of technological development--highly-specialized enterprises with great know-how managed to utilize the residual existing innovation potential for themselves.

Apart from the videorecorder and electron microscope sectors--judging by foreign patent applications--the United States is German industry's most important technological competitor in all other sectors.

Looking at it overall, the selected foreign trade sectors reveal a rather divergent picture. We must however keep in mind that German industry also achieved foreign trade successes which are not based on an outstanding position in technological progress. To be able to draw conclusions for the individual sectors, we need a more detailed study of this development. In the following we will therefore discuss approaches to further investigations with the help of two examples--the machine-tool-building and vehicle-construction sectors. In this connection we have tables in the annex which illustrate the development of priorities and foreign patent applications between 1966 and 1981.

Detailed Investigations Necessary

In machine-tool-building, along with the industry as a whole, we first of all made a breakdown according to the type of processing (cutting or non-cutting) and we then selected for our study other important subdivisions because of their dynamic technological development. They include the following:

Systems for the control of feeder movements of tools or work pieces; this group thus encompasses an important part of automatic controls for machine tools;

Handling equipment and systems connected with conveyors for handling (moving) objects or bulk goods; this group offers an approach to the recording of technological developments essential for industrial robots;

Tool exchange systems;

Cucking equipment;

Welding and cutting with lasers.

Looking at it as a whole, the analysis showed that the FRG was in second place behind the United States--and definitely ahead of Japan--in foreign patent applications for the average of 1976-1981 (see Figure 1 [not included]). It must however be kept in mind that Japanese industry was able to increase its share further while the German share stagnated. Looking at cutting and non-cutting machine tools, we can on the whole observe similar situations. In the area of cutting machine tools, the United States and Japan to be sure show higher shares than in the area of non-cutting machine tools which shrinks in terms of the number of patent applications.

In the technological developments which were selected by way of example and which are important for the productivity advances of the metal-working industry, a considerably higher growth of foreign patent applications was attained during the period of 1976-1981 as against 1972-1975 than for the average of the entire machine-tool-building industry (2.2 percent):

| | |
|---|---|
| For high-performance lasers for metal-working | 107.9% |
| For handling systems | 27.3% |
| For tool exchange systems | 52.9% |
| For chucking equipment | 22.4% |

In all four areas, the share of German patent applications went up even further so that one may assume that the German machine-tool industry decisively promotes development in these fields of technological progress.

But one must not overlook the fact that in this sector likewise less dynamic developments are to be observed. For example, looking at systems for controlling feeder movements, the share of Japanese foreign patent applications doubled toward the end of the 1970's, so that Japan takes first place here with 22.7 percent. The German share is in third place with 10.7 percent. This also reveals the already previously[10] observed weakness of German machine-building in the field of electronic controls. Strength in other subsectors is impaired by weakness in this field which is essential to the development of smart machine tools.

In the sector of motor vehicle engineering, along with the following subdivisions:

Combustion engines, their regulation and control,

Motor vehicle electrical systems and

Motor vehicle electronics,

We also selected the following sectors which are important in safety engineering:

Interval warning systems and

ABS (antiblocking protection systems),

As well as the following sectors because of the particularly dynamic development of foreign patent applications:

Regulation mechanisms for drive components (gears),

Waste-gas-powered pumps,

Safety, indication [dial], and surveillance systems, as well as

Electrical regulation of fuel injection.

Looking at motor vehicles as a whole and also in the subdivisions mentioned, the shares of German patent applications abroad increased. In most cases they

are only a little short of the American share (see Figure 2 [not included]). Looking at the dynamic sectors, we are struck, on the one hand, by the heavy loss of shares for regulating mechanisms for drive components (more than 5 percentage points) and, on the other hand, by the increase in German foreign patent applications for combustion engines and waste-gas-energy-driven pumps (just about 7 percentage points). In all of these three search fields we can record a considerable increase in Japanese patent efforts. This does not apply to all fields. In the case of interval warning systems, German research and development is in the lead with 29 percent of all foreign patent applications, followed by the United States, France, and, way behind, Japan. In the field of regulation and control of combustion engines--which is very important for the technological development of the motor vehicle industry--we however observe a very great increase in the Japanese share of foreign patent applications; during the period covered by this report, it grew from 17.6 to 23.4 percent, while the German share only went up from 24.1 to 25.0 percent. In this field, German industry's position is still satisfactory. In the subgroup of electronic regulation for fuel injection on the other hand Japan is already in a leading position; its share rose from 9.8 to 29.2 percent whereas the German share dropped from 28.9 to 22.0 percent!

Great Increase in Research and Development Employees

If we compare the United States, Japan, and the FRG, then we can record the greatest increase in the number of persons employed in R&D in the FRG (Table 5); this applies not only to the entire period of time observed between 1967 and 1979 but also to the last 4 available years. A very great increase was observed during these last few years also in the United States. In absolute figures, the increase between 1975 and 1980 was 90,000 persons in the United States as compared to 50,000 in the FRG so that the United States was in a leading position here. If we look at the growth rates of persons employed in R&D in the Japanese processing industry, we are struck by the relatively uniform increase compared to the FRG and the United States. There was above all no reduction in the R&D personnel force. Looking at sector growth for persons employed in R&D, we find that we can record above-average increases in the vehicle-building sector in all three countries considered in recent years. The main emphasis in growth was to be found in the FRG in the machine-building sector (including office machines and data processing) whereas in Japan it was in the electrotechnical industry.

Table 5. Changes in R&D Employment Figures in Selected Sectors, %

| 1 Sektor/Land | 67-69 | 69-71 | 71-73 | 73-75 | 75-77 | 77-79 | 67-79 | 75-79 | FuE Total Manpower 2 1979 |
|---|---|---|---|---|---|---|---|---|---|
| 3 Elektrotechnik | | | | | | | | | |
| 9 BR Deutschland | 35,7 | 9,7 | 0,3 | - 0,6 | - 0,03 | 19,7 | 77,6 | 19,7 | 66 472 |
| Japan | 35,5 | 10,9 | 12,0 | 3,9 | 3,5 | 12,1 | 102,9 | 16,1 | 83 557 |
| USA | 2,0 | - 12,7 | - 4,2 | - 3,0 | 4,1 | 9,3 | - 5,8 | 13,9 | 92 800 |
| 4 Maschinenbau | | | | | | | | | |
| 9 BR Deutschland | 16,6 | 74,3 | 0,1 | 7,2 | 12,5 | 41,2 | 246,7 | 58,9 | 38 954 |
| Japan | 5,4 | 29,5 | - 7,9 | 1,9 | 2,2 | 2,0 | 33,4 | 4,2 | 35 400 |
| USA | 15,6 | 5,2 | 12,6 | 11,5 | 4,0 | 11,9 | 77,3 | 16,3 | 63 100 |
| 5 Straßenfahrzeugbau | | | | | | | | | |
| 9 BR Deutschland | 49,9 | 20,2 | -27,6 | 3,0 | 13,0 | 27,6 | 93,8 | 44,2 | 28 957 |
| Japan | 45,9 | 21,4 | 23,6 | 18,5 | - 4,6 | 13,7 | 181,9 | 8,4 | 38 942 |
| USA | – | – | – | - 7,6 | 14,6 | 15,1 | – | 31,9 | 33 900 |
| 6 Chemie | | | | | | | | | |
| 9 BR Deutschland | 2,2 | 1,6 | - 5,9 | 2,7 | 12,7 | - 2,6 | 10,1 | 9,7 | 53 511 |
| Japan | 15,5 | 6,7 | - 4,8 | 4,7 | - 0,8 | 4,8 | 27,8 | 4,0 | 62 450 |
| USA | 5,7 | 4,5 | - 1,2 | 8,3 | 5,1 | 6,8 | 32,7 | 12,3 | 50 300 |
| 7 Eisen und Stahl | | | | | | | | | |
| 9 BR Deutschland | - 8,2 | - 30,6 | - 18,5 | - 12,4 | - 6,9 | -25,8 | - 46,7 | 17,1 | 3 861 |
| Japan | 7,6 | 7,8 | 10,3 | - 2,5 | 3,5 | 0,7 | 29,9 | 4,2 | 11 557 |
| USA | – | 6,3 | - 4,4 | 10,8 | 5,6 | 0 | 18,8 | 5,6 | 3 800 |
| 8 Verarbeitende Industrie | | | | | | | | | |
| 9 BR Deutschland | 21,4 | 14,1 | - 5,6 | - 1,7 | 6,5 | 20,7 | 65,3 | 28,6 | 228 579 |
| Japan | 16,9 | 10,8 | 8,0 | 5,8 | - 0,9 | 8,8 | 59,4 | 7,8 | 313 515 |
| USA | 3,5, | - 7,2 | 0,2 | 1,5 | 8,2 | 11,5 | 17,8 | 20,6 | 420 900 |

Key; 1--Sector, country; 2--R&D; 3--Electrotechnology; 4--Machine-building; 5--Road vehicle-building; 6--Chemical industry; 7--Iron and steel; 8--Processing industry; 9--FRG. Source: OECD, R&D data bank.

Share of Scientists and Engineers Still Lagging

German industry's leading position in the increase of R&D employees is considerably relativized if one includes the development of the share of scientists and engineers in the study. As Table 6 shows us, this share was continually increased in Japan while an increase can be observed only until 1977 in the FRG; at the same time, the share was considerably smaller. Looking at the increase in the number of persons employed in R&D between 1977 and 1979, the share of scientists and engineers did not increase in the same way; it dropped by 2.4 percentage points in the entire processing industry. It is interesting to note that this above all involves machine-building and electrotechnology. One cannot rule out the possibility that scientists and engineers were available for R&D to a lesser degree than other employees.[11]

Table 6. Share of Scientists and Engineers among R&D Personnel, Total, in Selected Sectors, %

| | | 1967 | | 1971 | | 1975 | | 1977 | | 1979 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | BRD | Japan | BRD | Japan | BRD | Japan | BRD | Japan | BRD | Japan |
| ...ktrotechnik | 1 | 40,6 | 38,1 | 36,9 | 42,8 | 45,4 | 50,9 | 45,0 | 59,1 | 41,1 | 60,5 |
| ...mie | 2 | 16,6 | 39,0 | 16,5 | 41,9 | 19,7 | 46,0 | 21,0 | 49,0 | 20,6 | 50,0 |
| ...ßen-...rzeugbau | 3 | 18,8 | 28,6 | 17,9 | 25,7 | 23,1 | 29,7 | 23,0 | 28,5 | 22,6 | 30,9 |
| Maschinenbau | 4 | 36,0 | 42,8 | 33,6 | 45,7 | 35,5 | 55,9 | 40,9 | 52,7 | 35,2 | 57,0 |
| Eisen und Stahl | 5 | 32,4 | 30,8 | 29,9 | 36,5 | 26,1 | 34,4 | 26,1 | 28,8 | 23,4 | 38,4 |
| Verarbeitende Industrie | 6 | 27,9 | 38,9 | 28,0 | 41,2 | 32,7 | 46,6 | 33,1 | 49,8 | 30,7 | 52,1 |

Key: 1--Electrotechnology; 2--Chemical industry; 3--Road vehicle-building; 4--Machine-building; 5--Iron and steel; 6--Processing industry; BRD--FRG; Source: OECD, R&D data bank.

Japan's sales successes on the world markets, which are greater when compared to those of the FRG, lead us to assume that qualitative viewpoints are more significant in an evaluation of R&D personnel than an increase in the personnel force as a whole. In this connection it is interesting to note that the French government's plans for the development of the research potential provide for training 4.5 percent more researchers and engineers annually and also to make corresponding jobs available.[12]

Declining Trend in Government R&D Promotion in Most Industrial Countries

In an earlier publication[13] we stated that in Japan, the financing of R&D expenditures in the economy sector in 1975 was provided to the extent of 98 percent by the economy itself while the corresponding share in the FRG was only 78.8 percent. As Table 7 shows, this trend toward government promotion was further strengthened in the FRG while the share of government-financed research in the economy sector declined in all other countries.[14]

Table 7. Economy Sector's R&D Expenditure Financing

| Land 1 | 2 Anteil des Wirtschafts-sektors an den FuE-Ausgaben insges. (in %) | | 3 davon finanziert durch | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 4 Wirtschaft | | 5 Staat | | 6 Sonstige a) | |
| | 1975 | 1979 | 1975 | 1979 | 1975 | 1979 | 1975 | 1979 |
| BR Deutschland b) 7 | 66,4 | 72,3 | 78,8 | 79,4 | 17,9 | 18,3 | 3,3 | 2,4 |
| Japan b) | 64,3 | 65,3 | 98,0 | 98,5 | 1,7 | 1,4 | 0,3 | 0,2 |
| USA | 65,9 | 67,6 | 62,8 | 67,2 | 37,2 | 32,8 | – | – |
| Frankreich 8 | 59,6 | 59,5 | 68,9 | 71,3 | 25,4 | 21,7 | 5,7 | 7,1 |
| Großbritannien b) 9 | 62,7 | 66,2 | 62,8 | 62,8 | 30,9 | 29,3 | 6,3 | 8,0 |

Key: 1--Country; 2--Share of economy sectors out of R&D expenditures, total, %; 3--Including shares financied by the following; 4--Economy [private industry]; 5--Government; 6--Miscellaneous (a); 7--FRG (b); 8--France; 9--Great Britain (b); (a) Non-profit institutes and foreign countries; (b) Excluding the arts and social sciences. Source: OECD, R&D data bank.

FRG Still in Second Place after United States

As we can tell from the empirical analysis of trade in technology-intensive products, of patent activities, and of the number of persons employed in R&D on a global level, the FRG is still in second place behind the United States in technological competition. The analysis did not provide any hint to the effect that this standing might be threatened in medium-range terms even if we consider the differing time frame of the individual indicators. The FRG of course is also definitely behind Japan in the field of microelectronics application.

General statements about the technological position and the effect of technological efforts however always contain the danger that differing developments in important subsectors are simply equated. It follows from this also that technological efforts can yield immediate economic success only if they are made in a specifically target-oriented fashion on the basis of a detailed analysis of the technological competitive positions in the individual subject fields. The promotion of innovative efforts must--to the extent that it is supposed to go beyond measures for the promotion of the innovation climate--be preceded by such a detailed analysis. Otherwise one cannot rule out the possibility that one will also promote technologically successful offerors who are already saturating their market.

FOOTNOTES

1. See IFO Institute of Economic Research, "Analysis of the Structural Development of the German Economy (IFO Structural Report for 1980)," SCHRIFTENREIHE DES IFO INSTITUTS FUER WIRTSCHAFTSFORSCHUNG [Publication Series of the IFO Economic Research Institute], No 107, Berlin-Munich, 1981.

2. Konrad Faust, "Patent Data as Early Indicators of the Technological Position of Competing Industrial Countries," IFO-SCHNELLDIENST, No 27, 1981.

3. Commission of the European Communities, "The Competitiveness of European Community Industry," Document No 11/387/82.

4. HWWA, "Strukturbericht 1980," Material Vol 2, Foreign Trade Structure Data, Hamburg, 1981.

5. IFO Structural Report, "Zwischenbericht" [Interim Report], Munich, 1979.

6. Aircraft sales by developing countries in 1980 also resulted in shifts of shares in the high-tech product sector.

7. See IFO Economic Research Institute, "Analyse der strukturellen Entwicklung der deutschen Wirtschaft" [Analysis of the German Economy's Structural Development], Method Vol, Chapter 4, IFO Publication Series No 107/II, Berlin-Munich, 1981.

8. [Not included]

9. [Not included]

10. See "Analyse der strukturellen Entwicklung der deutschen Wirtschaft," pp 382 ff.

11. This also corresponds to an investigation by the IFO Institute according to which we can record a shortage in the supply of engineers for machine-building and vehicle-building as well as electrical engineers. See W. Friedrich, "Engineer Requirements in Industry and in the Main Construction Industry," IFO-SCHNELLDIENST, No 7-8, 1982.

12. Ministry of Research and Technology (Publisher), "Research and Technology," Paris, 1981; quoted from UMSCHAU 82 [Survey 1982], No 6.

13. H. Blau, K. Faust, H. Schedl, "Japan's Competitive Position in Industrial Commodity Export," IFO-SCHNELLDIENST, 28, 1981.

14. This trend to be sure was reversed in France due to the change in administration in 1980. See Ministry of Research and Technology, loc. cit.

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# BUDGET, STRATEGY OF 1984 FRENCH ELECTRONICS, DP SECTOR

## Goals for Electronics Industry

Paris AFP SCIENCES in French 29 Sep 83 pp 7-9

[Text] "Winning the challenge of electronics and data processing": This was the essential theme of the 27 September Cabinet meeting, which also took up the industrial and scientific aspects of the topic, as well as its effects on the education, culture and daily life of the French people.

President Francois Mitterrand, who was quoted by spokesman Max Gallo, emphasized to the ministers the importance of the data processing item. "It is up to this government and this majority to make France take a qualitative leap in this field so that France will not miss the boat of the 21st century," the chief of state said.

For Mitterrand, "we must go with our strong suit and wherever we fight, we must win." In the field of education and training, he said, "we must shift gears."

At least five memorandums have been issued on the subject: one from Laurent Fabius, naturally, who heads industry and research, but also from Alain Savary and Roger Gerard Schwartzenberg for education, Marcel Rigout for professional training, and Jack Lang for culture.

### Industry and Research

The minister of industry and research presented the record and the prospects of action taken in the electronics field.

1 -- The prime objective of the government, he said, has been to lay the foundations of industrial development of electronics, strengthening the fields in which France already has a good position, such as telecommunications, telematics and automated money handling, civilian and military professional equipment and software, while filling the gaps existing in other sectors.

Various operations making it possible to arrive at greater efficiency in the distribution of the activities of national enterprises have taken place: the association of Thomson and the CGE [General Electricity Company] for telecommunications, general materials and military equipment, and consolidation and diversification of the Bull firm for data processing.

The research effort has been stepped up. Six national projects combining manufacturers and research centers will make it possible to facilitate transfers between research and industry. They will be completed by action taken in new fields such as robots.

Ambitious development action has been launched: for integrated circuits, that will have over 3 billion francs in public credits allocated over a period of 4 years; for video-communications (cable); for passive components, which will have 800 million francs over a period of 4 years; for data processing and general electronics; and for space, in which the effort was increased by 45 percent from 1982 to 1983.

A reorganization of administrative responsibilities within the Ministry of Industry and Research and the Postal and Telecommunications Administration has been undertaken in order better to exploit complementary features existing between the data processing and telecommunications sectors.

New action will be undertaken to encourage the development of international cooperation and in particular, European cooperation.

2 -- Dissemination of the applications of electronics is indispensable to the modernization and competitiveness of our economy. It will be continued and expanded, especially regarding small and medium-size enterprises. To that effect:

Financing from the industrial modernization fund will be granted first of all to action having to do with high technology machines, word processing and automated money handling, as well as the installation of microcomputers.

In order to promote innovation, a program of incentives for the utilization of micro-electronics in industrial products has been decided upon.

The Cabinet will soon examine a plan aimed at supporting the industrial supply of data processing equipment, automation and robots and the installation of such equipment in manufacturing industries.

The utilization of data processing and word processing will be encouraged in government offices and public organizations. New procedures will be defined on a contractual basis, with all partners concerned.

Finally, a plan to make people aware of and familiar with home computers will be carried out in cooperation with television.

In education, 20,000 young people will be trained in data processing and computers in 1983, studying for the certificate of professional studies. Another 8,500 will be trained as engineers and upper-level technicians.

Some 20,000 teachers will be trained in 1983-1984 alone and 20,000 minicomputers will enhance the level of national education in 1984. Equipment credits will be quadrupled since 1981 in higher education and five times greater in elementary and high school education, the Cabinet bulletin states.

By 1988, 100,000 minicomputers will have been delivered and 100,000 teachers will have been trained to use them.

With respect to continued professional training in data processing and computers, 3,500 spots have been opened up at all levels for 1983 and 1984, an initial "positive" grade for the "catchup plan" drawn up in July 1982.

In addition, 400 young volunteers from the quota have been recruited to train unemployed young people in data processing. Some 10,000 young people should complete training programs lasting from 5 to 10 months.

## Main Projects, Funding

Paris AFP SCIENCES in French 29 Sep 83 pp 27-30

[Text] A total budget of 1,350 [sic] francs has been devoted to public research relating to electronics objectives, defined as the "top priority of the industrial policy of this 7-year term" by Laurent Fabius at the close of the 27 September Cabinet meeting.

The budget will be increased to 1.55 billion in 1984, the Ministry of Industry and Research reports.

This research activity has combined the efforts of nearly 3,000 research workers and engineers, mainly belonging to teams from the CNRS [National Center for Scientific Research], university laboratories, INRIA [National Institute of Research in Data Processing and Automation], the CNET [National Center for Telecommunications Studies] and the AEC.

Public action in this field is complemented by incentive credits that will be increased to 750 million francs in 1984. These sums combine allocations from the research and technology fund, the data processing agency, ANVAR [National Agency for the Implementation of Research], DIELI [Electronics and Data Processing Industries Directorate], the DGA [General Arms Delegation] and the DGT [General Telecommunications Directorate]. The latter three devoted some 6 billion francs in 1983 to technological research and development in th^ sector.

Finally, the ministry reports, one should mention the importance to the development of electronics of research and programs under the CNES [National Center for Space Studies], especially relating to the Ariane project.

In July 1982, the government decided to launch national research and development projects dev ted to priority domains in which the knowledge of French experts could be fully utilized.

The definition of projects was the task of DESTI [Research and Technology Fund], following lengthy consultation with manufacturers, public research organizations and all government administrations concerned. On this basis, it was decided to launch six national projects devoted to the following subjects: a computer for scientific and industrial use (SM90); computer-aided design of

very highly integrated circuits (CAO-VLSI); software engineering; computer-aided design and manufacturing (CFAO); computer-aided translation (TAO); and visualization.

Over the next four years, these projects will be the recipients of research and development investments on the order of 1 billion francs, whose financing will be shared by the government and manufacturers involved.

Starting in 1983, 250 million francs in incentive credits will be allocated to these operations thanks to the mobilization of budgetary means of DESTI, the Data Processing Agency, DIELI, the General Telecommunications Directorate and the General Arms Delegation.

Each of the national projects mentioned above involves several actions. Some of them are still under study and will be spelled out in the months ahead. It is nevertheless possible to announce immediately the actual implementation of the following operations:

1) establishment of a public interest group involving the CNET, the SEMS [Electromechanical and Signal Company]-Bull Company, and INRIA for construction of a data processing center based on the SM90 machine designed by the CNET;

2) the building of a system for the design of very highly integrated logical circuits (100,000 to 1 million transistors) based on the new so-called "hierarchical" methods, by a public interest group including the Thomson-CSF [General Radio Company] and Bull companies, INRIA and the IMAG [expansion unknown] laboratory at the University of Grenoble. This operation is included in the CAO-VLSI project.

3) design of a graphic and image processing system by an industrial consortium headed by the CSEE [Electric Enterprises and Signals Company], with the aid of a group of users gathered together by CIGRET [Data Processing Club of Major French Enterprises];

4) establishment of an economic interest group (GIE) including Thomson-SYSECA [expansion unknown], Eurosoft and Bull, responsible for building the "host structure" software for the national software engineering project with the aid of the CAP-SOGETI [expansion unknown] company, which will ensure the transition between these developments and the Multipro equipment already in existence. This GIE will communicate to other manufacturers involved in the project the interface elements necessary for integration of specialized tools into this base;

5) industrialization by a consortium including the SG2, Copernique and Sonovision companies, with the support of Marcel Dassault Aircraft, of a system of automatic translation based on the work of the GETA [Study Group for Automatic Translation] and the university laboratory of Grenoble;

6) specialization of a specialized basic data system for computer-aided design and scientific and technical calculation entrusted to the CERT [Studies and Research Center of Toulouse] laboratory of ONERA [National Office for Aerospace

Studies and Research] and to the CISI [International Data Processing Services Company], Simulog and Assigraph, with the participation of Dassault-Systems;

7) development of the automatic vision and command module for robots and machines, entrusted to a consortium made up of Matra, Midi-Robots and the ITMI [expansion unknown], with participation of the PSA [expansion unknown] group and the LAAS [Automation and Systems Analysis Laboratory] (Toulouse) and IMAG (Grenoble) university laboratories; and

8) design of a direct robot command system, integrated into computer-aided design, entrusted to the Dassault-Systems Company and the LAM [expansion unknown] laboratory in Montpellier.

The last three operations are part of the national CFAO project.

In 1984, these actions will be continued on priority subjects already chosen and extended to several new areas. Work will be done in connection with research projects conducted by the EEC in which French manufacturers and laboratories are participating.

Finally, scientifically strategic domains, such as artificial intelligence and research into parallelism and their relationship to specialized computers will have priority support, in order to enable our laboratories to maintain and improve their current knowledge at the highest international level.

Artificial Intelligence Research and Development Projects

Research and development within the framework of artificial intelligence involve fundamental aspects oriented toward a large number of scientific and industrial applications.

They will involve several research organizations and will mainly be based on the recommendations of the Artificial Intelligence Work Group of the CNRS and the SICO (Data Processing Systems of Knowledge) Club of INRIA, which presented a joint report in June 1983.

Development of equipment systems and software adapted, among other things, to artificial intelligence is within the guidelines of the national software engineering project.

These artificial intelligence actions can be extended to the European level, particularly within the framework of reflections underway for the establishment of the software technology and advanced information processing of the Esprit Program.

This question may also be taken up among the possible subjects for the JRI [expansion unknown] Research Center in Munich (shared by the ICL [expansion unknown], Siemens and Bull).

The government will also make an effort in the field of training, aimed at developing instruction in artificial intelligence and its applications at all levels.



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## FRENCH RESEARCH FUNDS, PRIORITIES FOR 1984-88 DETAILED

### Details of Ninth Plan

Paris AFP SCIENCES in French 22 Sep 83 pp 1-3

[Text] Paris--Research and innovation, industrial modernization, communications industries and energy independence figure among the high priority programs of the 9th Plan (1984-1988).

In disclosing the draft bill that has been drawn up in accordance with the guidelines adopted in July and which is to be submitted to Parliament some time in November, Mr Jean Le Garrec, secretary of state in charge of the plan, in Paris on 19 September, pointed out that this bill will, for the first time, be incorporated into the 1984 budget, that is, as of the first year of its application.

As of 1984, the PPE's [High-Prioritied Programs], a detailed and financial description of which is provided in the report that accompanies the text of the bill, will come to a total of 59.4 billion francs under various budgetary expenditure headings, an increase of the order of 16 percent with respect to a rate of expenditures limited to 6.3 percent for the 5 years of the plan [as published]. The plan calls for a total expenditure limited to 350.5 billion (constant) francs over the 5-year period.

### Outlay for Research

The outlay for research will be upped from 2.1 percent of the GDP [gross domestic product] to 2.5 percent in 1985 and will be limited to a total of 64 billion francs over the period of the 9th Plan.

This program is to promote the design and use of new technologies in the enterprises that will be executing 60 percent of the program, specifically without overlooking the PME's [Small- and Medium-Size Businesses] and farming operations. Its objective is to double, by 1988, the number of enterprises engaged in research and development, whose present number is around 1,400.

The situation with regard to patents is to be improved. The objective is to triple the number of filings through easier and less costly procedures.

To promote scientific and technical education and training, a network of scientific and technical education centers will be installed in the regions (15 in 5 years). The number of engineers to be trained by the Ministry of Research will be increased from the 1982 level of 500 to 1,500 annually in 1988, while the number of leaves of absence with pay for training in the leading-edge technologies will be increased from 750 in 1984 to 4,500 in 1988.

## Modernization of Industry

The modernization of industry, particularly that of the PME's and the crafts enterprises, will be funded up to a ceiling of about 20 billion francs.

The bill states that, to remain competitive and improve their shares of the market, the enterprises must embark on a decisive technological phase requiring the installation of automated manufacturing facilities, such as numerical controls, robots, industrial data processing and automated materials handling.

The bill seeks to encourage the lowering of production costs in the food processing, construction and public works sectors.

The modernization program will be structured in the direction of savings to be achieved in productive operations. In particular, the procurement of advanced-technology capital equipment will be facilitated by the FIM [Industrial Modernization Fund] and by CODEVI [Industrial Development Accounts].

## Communications Industries

The communications industries will be apportioned a budgetary ceiling of 21 billion francs to create a dynamic market in the audiovisual sector and to promote, therein, creativity, research and training.

Coverage of domestic market demand is to be improved: The French computer manufacturers' share of the domestic market is to be increased from 29 percent of the present market to 50 percent in 1988, and the number of general-public type software systems produced is to be increased from 80 in 1983 to 400 in 1988.

An audiovisual production support fund will be created and financed temporarily by budgetary allocations, which will be replaced gradually by a tax that should provide for the production of 300 hours more of programming beginning in 1986.

## Energy Independence

The government is planning to spend 15.4 billion francs over the period of the 9th Plan to bring the country up to an energy-independent level of 50 percent in 1990 (35 percent in 1982).

Funding of PPE's
(in Millions of Francs)

| Programs | 1984 Budget | Total 1984-1988 |
|---|---|---|
| Modernization of industry | 3,183 | 19,900 |
| Renovation of educational system | 16,610 | 91,531 |
| Research and innovation | 10,650 | 64,194 |
| Communications industries | 3,594 | 21,190 |
| Energy independence | 2,767 | 15,462 |
| Subsidization of employment | 5,356 | 36,278 |
| Sales promotion in France and abroad | 4,686 | 27,707 |
| Family and birth allowances | 225 | 1,305 |
| Decentralization | 3,299 | 21.047 |
| City cost-of-living allowances | 2,588 | 15,147 |
| Public health system | 5,114 | 28,693 |
| Justice and security | 1,339 | 8,095 |
| Total | 59,411 | 350,549 |

It is counting on an increased penetration of electricity into the industrial sector, an improvement of energy-performance levels in buildings (insulation), the promotion of renewable energy sources (solar, residual heat, biomass) and a lowering of fuel consumption by automotive vehicles.

In the industrial sector, the bill states that the EDF [French Electric Power Company] "will offer long-term contracts, setting the price of electricity in accordance with parameters based on the structure of production costs."

The bill also states that France's energy policy must be based on "long-term perspectives," and must not fluctuate "at the whim of variations in the price of oil."

The bill further provides for the start of construction of the TGV Atlantique [Atlantic High-Speed Transportation System], which will put Bordeaux 3 hours away from Paris, "at the beginning of the 9th Plan."

This operation, announced on 15 September by President Mitterrand, "will be subsidized by the state to the extent of 30 percent to cover infrastructures."

Financing of the PPE's

The 12 PPE's are to be financed, in the 1984 budget and for the period of the 9th Plan, as shown in the accompanying table.

## Details of Research Budget

Paris AFP SCIENCES in French 22 Sep 83 pp 4-5

[Text] Paris--The 1984 Budget Bill was definitively adopted on 21 September by the Council of Ministers.

Civilian budget credits to be opened for 1984 total 845,778 million francs, up 6.5 percent over 1983.

The defense budget will rise by 7.6 percent to 171,020 million francs.

Continuing Outlays for Research

The civilian research budget for 1984 will show an increase of 15.48 percent in terms of value, or 8.3 percent in volume [see table]. This increase is less than the one in 1983 (+17.8 percent in volume) and in 1982 (+14.1 percent) over the immediately preceding years, but it is much greater than the average rate of increase in the national budget as a whole.

A net total of 910 newly created jobs and 426 conversions from temporary to permanent job status will be added to the human resources being devoted to the research effort.

Civilian Research Budget Figures
(in Millions of Francs)

| | 1982 | 1983 | 1984 |
|---|---|---|---|
| (a) AP | 12.702,10 | 17.310,68 | 20.680,56 (1) |
| (b) CP | 10.753,69 | 15.224,41 | 17.993,17 (1) |
| (c) DO | 12.713,09 | 15.215,79 | 16. 883,58 |
| (a) AP + (c) DO | 25.415,19 | 32.526,47 | 37.564,24 (1) |
| (d) Croissance en volume | + 14,1 % | + 17,8 % | + 8,3 % |

(1) Including 750 million francs of tax revenues lost from institution of research tax credit.

Key:

a. Program authorizations [new].

b. Outpayment appropriations [under existing programs].

c. General expenses [not chargeable to programs].

d. Increase in volume.

[JPRS note: This chart is reproduced from the French source. English usage calls for reversal of periods and commas: thus 12.702.10 million (Fr) would be 12,702.10 million (US)]

In the research budget for 1984, priority is being given to--besides the space programs being conducted by the CNES [National Space Studies Center], which show an increase of 33.5 percent--credits to provide incentives to research and innovation in the enterprises.

ANVAR [National Agency for the Development of Research] subsidies in support of innovation will be 906.3 million francs, up from the previous year's 820 million francs (+10.5 percent). The essential reform in this domain is the replacement of ANVAR's innovation bonus procedure by a provision that is more general in scope: A tax credit for enterprises that develop their own research effort. This tax credit, voted in Parliament in 1982, will be incorporated in a budget for the first time, namely, the one for 1984. Estimated to amount to 750 million francs, it represents a very substantial inducement being granted to the enterprises.

Similarly, the credits being allocated to the Research and Technology Fund, 35 percent of which go directly to the enterprises, are being increased from 1,018 million francs to 1,219 million francs (+19.8 percent).

The electronics sector will be drawing on the civilian research budget to the extent of 2,800 million francs (+32 percent), out of overall budgetary appropriations totaling 3,800 million francs.

Thus, the part of the civilian research budget devoted to the enterprises will increase by 20.66 percent over 1983. It will represent over 27 percent of the research budget.

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## NEW SWISS SERVICE TO AID R & D, TECH TRANSFER

Bern TECHNISCHE RUNDSCHAU in German 5 Apr 83 p 35

/Article: "Promising Innovations with FITT"/

/Excerpts/ Last fall the Aargau Chamber of Industry and Commerce presented the new service FITT (Research and Development Institute for Technology Transfer). The goal of this service, which is not meant to be restricted to the canton of Aargau, is to support smaller and mid-sized firms in the application of the newest technologies. What FITT is and does were explained in short accounts by Dr Ernst Fahrlander, President of the Aargau Chamber of Industry and Commerce (AIHK), Dr Rolf Mauch, Director of the Secretariat of AIHK, and Professor Walter Guttropf.

What is FITT?

With the rapid progress of innovative techniques it becomes a necessity for survival, especially for the smaller and mid-size organization in any line of business, to deal intensively with this development, which is deeply influenced by electronics. Businesses, which today are still in the majority structured along conventional mechanical or business lines face an almost insoluble problem in coping with reorganization. In addition--and this is a special threat to our economy--there is a very large number of firms that find themselves in this situation.

FITT is a system that offers firms of all sorts the possibility of coping actively with the change of structure.

FITT's service is made possible by the Aargau Chamber of Industry and Commerce (AIHK) together with the faculty of the Brugg-Windisch Institute of Technology.

The components of the FITT system extend from short consultations, through the research and development components, to the components of training information shows, and information systems.

FITT offers many forms of consultation and cooperation, which may go beyond the limits of the GWTech consultant.

With the activation of the great potential of term papers and theses a low-cost entry is made possible.

FITT represents no competition for consulting firms, but on the contrary is intended, by opening up a realm of firms which hitherto have been strangers to external consultants, to provide the consulting firms with an entry to these organizations.

Who Needs FITT?

The circle of users extends from production firms of all sorts, by way of service firms, to groups, managements, and administrations. The problems involved can be purely technical, but they can also involve matters of economics and of training technology. If the result desired cannot be accomplished within the system itself, contacts with other providers can be mediated. These may be consulting firms, manufacturers and suppliers, institutes, and so forth. Since especially microelectronics and data processing represent the touchstones for every company in any field, every firm of whatever size must ask itself where innovative measures must be taken in product, production, process or service in order to maintain and improve competitiveness. (The USA and Japan turn over about 50 Swiss francs pro capita per year; in the FRG the figure is only about 20 Swiss francs; that for Switzerland might perhaps be still lower.)

Where will FITT be active?

By no means can all the problem areas be listed here. But a selection of examples may permit the very broad outlines to be discerned.

Technology Transfer (TT), which has been up and running successfully for a year and a half, has targets of consultation in electronics, microelectronics and microcomputers, data processing in the technical and commercial fields, modern production processes, robot applications, etc., energy optimization, heat recovery and environmental protection, modern materials, physical technology, building technology, and plastics. Potential areas of activity of FITT are realms such as modern office technology, the application of microelectronics in agriculture, computer-supported assembly, microcomputer applications in small businesses, in special branches, and in the schools. Questions of logistics belong here, as do decision calculations for process optimization.

How does FITT function?

FITT is meant to function in the areas of industrial and economic innovation. That means the introduction of a new product, a new manner of production, a new operation, or a new service: some process which the firm cannot afford routinely and with its own ways and means.

FITT services are supplied in the first instance by faculty members on a basis of free-lance consulting activity. The different possibilities here range from complete consultation to cooperative consultation with personnel of the contracting firm.

Term papers and theses can be devoted entirely to this process. They form a great potential, not yet much exploited, for valuable pre-development.

The consultation can take place at Brugg-Windisch Tech, where the modern equipment of the Institute is available. Of course consultative services can also be mediated through others or be built in directly.

Structurally this component of Research and Development ranges from short conferences (1/2 day) up to cooperation for years. When innovative technologies have to be disseminated swiftly, training is a decisive element among the target firms. The possibilities here range from the training of company interns through courses and seminars to postgraduate study, as this has been being done successfully for some time, for instance, at BWTech in plastics technology.

With the information show component the FITT center plans to present concerted hardware demonstrations for currently relevant innovation technologies. Thereby the interested parties are to gain the possibility of judging their special situations concretely.

Since, again, the Technical Institute with its facilities is to be at the focus, one can expect increasing relevance of its own training programs.

With the component information systems rapid and competent transmission of information is to be made feasible.

FITT keeps special data banks via the BWTech consultants, supplies data banks with problem-specific adaptations for brochures and literature. FITT sets up data banks in the firms and mediates data bank services by other organizations.

Setting up a FITT teletext system is being intensively considered. The presently existing terminal connection with the ETHZ /Eidgenoessische Technische Hochschule Zuerich: National Swiss Institute of Technology in Zurich/ library also finds manifold use in FITT.

The New Raw Material Information

If the system can be successfully brought into play in a broader context, the opportunity for a rapid dissemination of innovative technology will be made real. The new technologies are determined in the first instanee by the new raw material information.

FITT intents to contribute to enabling exploitation of the new raw material, the new commodity "information" in many businesses.

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